



## Report for the 2014 DCEE Working Group Meeting

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# Report for the 2014 DCEE Working Group Meeting

Summary by: Lotte Bjerregaard Jensen and Mary Kathryn Thompson

## Introduction

The DCEE 2014 meeting at the Technical University of Denmark focused on interdisciplinarity in design processes while embracing the central issues of the previous workshops: design tools / methods and design education in Civil and Environmental Engineering (CEE).

## Interdisciplinarity

Interdisciplinarity runs through design in civil and environmental engineering and links all of the associated disciplines. For example, architects are not interested in HVAC. They are interested in how the building looks and where and how to place the windows. However these design choices influence the design of the HVAC system. The HVAC system design can, in turn, influence how a building's internal support structure must be designed and built and vice versa. The order in which these decisions are made sets the constraints that affect the decisions to come. But they often do not need to be made in a specific order. This places all of the disciplines at an equal level and requires them to work together instead for each other.

Since the earliest decisions impact all of the decisions to come, it is important that the decision making process is infused with engineering and scientific knowledge from the beginning. The many levels of decisions that need to be made over long periods of time must be based on broad and deep knowledge that cannot be held by a single person or discipline.

Larger civil design projects are usually commissioned and funded by the public. The politicians overseeing this process are aware of the complexity involved and also require a higher level of information to support their decision making processes. Thus, it will benefit all internal stakeholders to enhance transparency by advancing systematic interdisciplinary design processes and by developing and improving tools to inform the design process.

Finally, Civil and Environmental Engineering design processes are complex from the very beginning due to their scale and site specificity. Design methods which incorporate interdisciplinary perspectives are needed to help understand and manage this complexity.

One of the most important questions in this context is: Who are the stakeholders and the

participants in interdisciplinary design processes in Civil and Environmental Engineering? While social scientists are needed to add knowledge and perspective, often the social scientists working in these areas have an engineering background. If interdisciplinarity work requires multidisciplinary participants, the cost associated with educating those people will be very high and their availability will be relatively low. Does this make interdisciplinarity then out of reach for many projects?

Finally, is interdisciplinarity in design processes a question of evidence-based design? Does evidence based design lead to overly conservative decisions since they can only be based on well documented and proven ideas? Does this represent a design dilemma?

The interdisciplinary approach, its requirements, and its implications could be the focus of forthcoming workshops. Design methods could then be viewed as a broader subject. Perhaps this approach would allow design methods to be more precise in meeting current demands.

## Grand Challenges

The 2014 workshop highlighted the fact that the world and its climate are changing. Thus, the types of design problems that currently need to be addressed and that will need to be addressed in the near future are changing. This increases the need to focus on improving design tools and processes to meet these needs.

### Climate Change

From the technical presentations and from the breakout sessions, it is very clear that climate change related flooding is occurring all over the world. This changes the nature of our cities temporarily when impacted by more frequent micro bursts and 100-year or 1000-year rain events. It will also change the nature of coastal cities permanently as sea levels rise. This means that main stream solutions are no longer applicable. New requirements and constraints have been and will be added and new design parameters are and will be needed to address those needs.

### Renewable Energy

Another grand challenge facing CEE engineers is the demand for 100% renewable solutions. The production of renewable energy depends on natural phenomena (sun, wind, waves, etc.). Although the long term availability of these resources is reasonably

well known and can be used for planning, natural resources tend to have more short term fluctuations than fossil fuel or nuclear energy sources. Thus, it is more difficult to plan for and to meet the needs of the population and of industry.

These sorts of challenges are disruptive to the status quo. They require new design methods and new disruptive technologies to be developed to address these needs. Therefore we need to think more and differently about design processes in Civil and Environmental Engineering.

### **Globalization**

Civil and Environmental Engineering projects are always related to and influenced by their location, the local climate, economy, and culture, and so on. Therefore, globalization changes our views on design processes. Historically, Asia had one tradition for design and one framework for design processes. Europe had another. The US had a third way to perform design. Now we are literally and figuratively speaking the same language. This enables us to share ideas and information internationally far more than before. But it also means that our designers and our construction industries have to work together and to compete with each other in a new way. The implications of this are not yet well understood and could be addressed in future workshops.

### **Teaching**

Students in CEE are usually highly motivated and want to help address important problems and grand challenges associated with climate change, energy, environment, water and sustainability. Universities are good at teaching the fundamentals that will allow students to address the aforementioned problems. But many programs lack integrative experiences that provide students with the experience to do so. The working group asked: should design challenges be addressed by a design tradition, by a systematic design methodology, through practice via integrative experiences, by a combination, or using some other approach? Would it be valuable for this community to explore design tools and methods in an interdisciplinary environment by offering joint project-based grand-challenge-focused international short or summer courses?

### **Mapping of Related Fora: What is Unique in Design in Civil and Environmental Engineering?**

Design applications in the fields within Civil and Environmental Engineering (water treatment, structural engineering, etc.) can be, and currently are being, presented at conferences and in journals related to those fields. Design within the 'silos' are usually well represented in the associated literature.

Papers related to Civil and Environmental Engineering education and curriculum development have established fora within engineering education. For example, the American Society for Engineering Education (ASEE) has a division dedicated to civil engineering and another dedicated to design education.

In addition, there are already conferences associated with topics that are related to design such as Building Information Management (BIM) and digital design tools in general. These topics are part of and support advanced design processes.

What we believe is unique about DCEE is its holistic perspective. This workshop provides a forum that welcomes design from all of the disciplines within CEE, that allows an integrated and interdisciplinary perspective and approach to design, that is independent of any given tool or technique, and that emphasizes the design process and design methods. DCEE must preserve this openness in order to continue to foster the interdisciplinarity necessary to address specific projects from CEE related technical and scientific fields as well as the grand challenges that cross them.

### **DCEE Community**

Finally, the working group addressed the status and evolution of the DCEE community. A question was raised about the need to formalize the DCEE community. For example, does DCEE need to form or join a professional society of some sort? This seems to be a critical question for the next few years.

### **Publication Options**

Similarly, the group discussed the need for and the founding of a civil design journal. This would help to formalize the community and would greatly increase the visibility and the impact of the community. However, it is also a substantial undertaking. There is great enthusiasm and support to do this. But it is not yet clear that there is critical mass for a dedicated civil design journal. For now, the participants agreed to investigate options to increase the visibility and impact of the workshop proceedings and to organize a special issue related to design in CEE in an existing journal.

### **DCEE Meetings**

The group discussed the format of future meetings. Participants like the single (plenary) sessions that are currently offered. But this limits the meeting to a maximum of 60 to 80 participants. The consensus is to try to keep the workshop character for now but also to ensure that the meeting is open and inclusive. If this requires parallel sessions, an increase in poster presentations, or other adjustments, these will be made. The participants of the 2014 meeting also liked

the breakout sessions and wanted to continue to invite and embed industry in the workshop.

### **Benefits and Challenges for the Hosting Organization**

Finally, the team from DTU noted that organizing and hosting the workshop provided a valuable opportunity for self-reflection and a platform for communication about design research that has been conducted in CEE over the past 15 years. The workshop showed both local and international participants how much work has been done in integrated design and integrated energy design at DTU. It also showed that there have been different cycles of research in design methods in different parts of the university over the years.

Participants who are interested in hosting the workshop in future years noted that it is important to ensure a smooth and easy transition from one team to the next. Resources are always limited. They should be spent on the technical issues and building the

community, rather than on replicating work that has been done by others.

### **Activities Outside of the DCEE Workshops**

DCEE has not yet settled into an annual or biannual format. Members of the community stressed the importance of meeting once a year, even if the workshop is held biannually. If this is not possible, an online discussion or platform might be necessary to ensure that the bonds between the members are maintained and strengthened.

Several options for participation outside of the workshops were discussed. It was concluded that collaboration was likely to take place pairwise and outside of the workshop framework. No formal action is needed for these types of activities. However, formal exchanges of students, PhD summer schools and other types of short courses are all concrete and relatively easy ways to remain active and explore specific issues related to design in CEE between workshops. Special sessions on design in CEE can also be organized at other meetings related to the CEE domains or special topics such as BIM.